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Characteristics of lightning flashes generating dancing sprites above thunderstorms

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During the night of October 29-30, 2013, a low-light video camera at Pic du Midi (2877 m) in the French Pyrénées, recorded TLEs above a very active storm over the Mediterranean Sea. The minimum cloud top temperature reached -73°C at ~ 1600 UTC while its cloud to ground (CG) flash rate reached ~ 30 fl min^{-1} . Some sprite events with long duration are classified as dancing sprites. We analyze in detail the temporal evolution and estimated location of sprite elements for two cases of these events. They consist in series of sprite sequences with a duration that exceeds 1 second. By associating the cloud structure, the lightning activity, the electric field radiated in a broad range of low frequencies and the current moment waveform of the lightning strokes, some findings are highlighted: (i) In each series, successive sprite sequences reflect the occurrence time and location of individual positive lightning strokes across the stratiform region. (ii) The longer time-delayed (> 20 ms) sprite elements correspond to the lower impulsive charge moment changes (iCMC) of the parent stroke (< 200 C km) and they are shifted few tens of kilometres from their SP+CG stroke. However, both short and long time-delayed sprite elements also occur after strokes that produce a large iCMC and that are followed by a continuing current. (iii) The long time-delayed sprite elements produced during the continuing current correspond to surges in the current moment waveform. They occur sometimes at an altitude apparently lower than the previous short time-delayed sprite elements, possibly because of the lowered altitude of the ionosphere potential. (iv) The largest and brightest sprite elements produce significant current signatures, visible when their delay is not too short (~ 3 -5 ms).